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Play Space Safety

Alberta

RECREATION AND PARKS

Recreation Development Division

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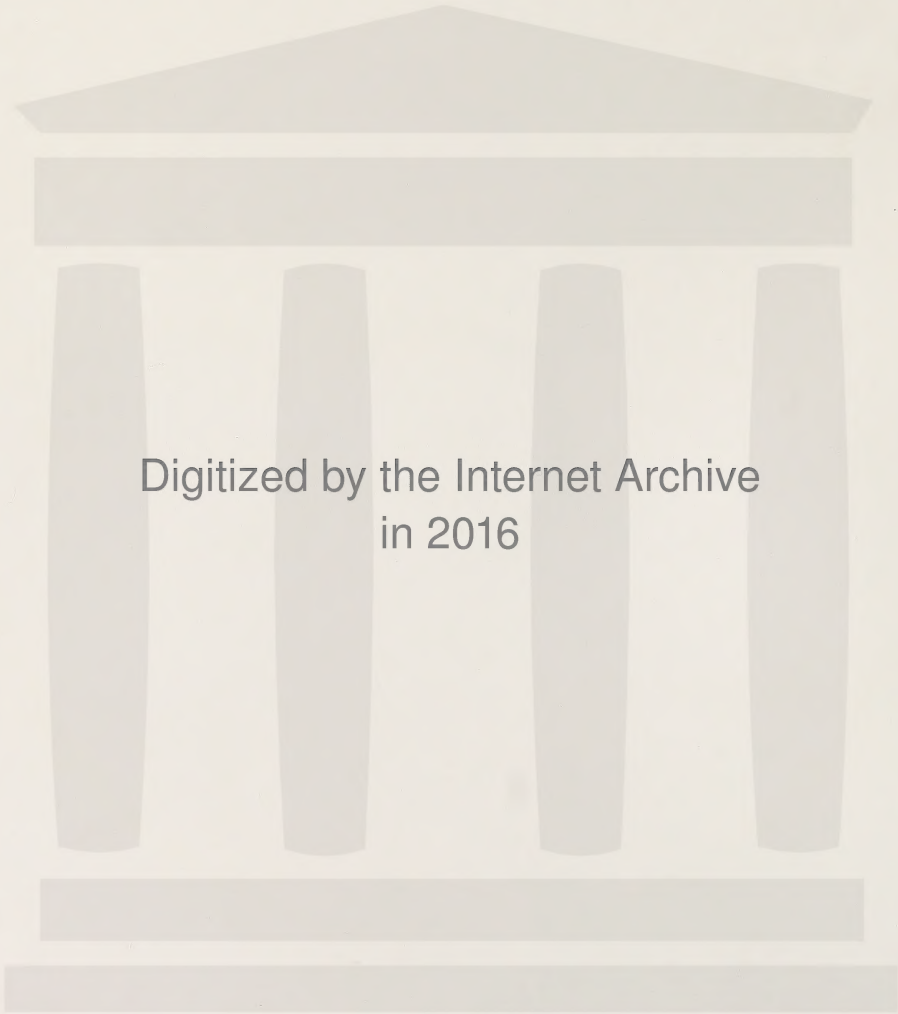
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ACKNOWLEDGEMENT

The material in this manual is based on the research and writing of Steen B. Esbensen, Professor of Early Childhood Education at the Université du Québec à Hull, Québec.

Professor Esbensen has been active in environmental design consultation and research on children's environments since 1969 and is a recognized authority on the evaluation of children's play spaces and equipment in terms of their safety, play value and appeal.

This manual, produced with Professor Esbensen's assistance, is designed to help adults, including landscape artists, recreation planners, teachers and parents, design and construct - or evaluate and redesign - play spaces and equipment for children.

Since research reveals that children aged one to nine are most prone to playground-related accidents, Professor Esbensen's investigations - along with the contents of this manual - are concerned primarily with this age group.

INTRODUCTION

Play areas in public places - in school yards, at housing developments, in conjunction with day care centres, nursery schools and kindergartens - presumably have a common purpose. They're there to allow children to interact with each other, to climb, slide, swing - or simply sit and talk. They're there to encourage imaginative activity by allowing youngsters to pretend, to create, to manipulate the materials they see around them.

The ideal is a well-designed site, landscaped and furnished with safe and stimulating materials and equipment. Sadly, not all play areas meet these criteria. This manual is offered therefore as a guide to creating play areas that are appealing and stimulating and, above all, safe for youngsters ranging from toddlers to eight or nine-year-olds.

SAFETY ISSUES

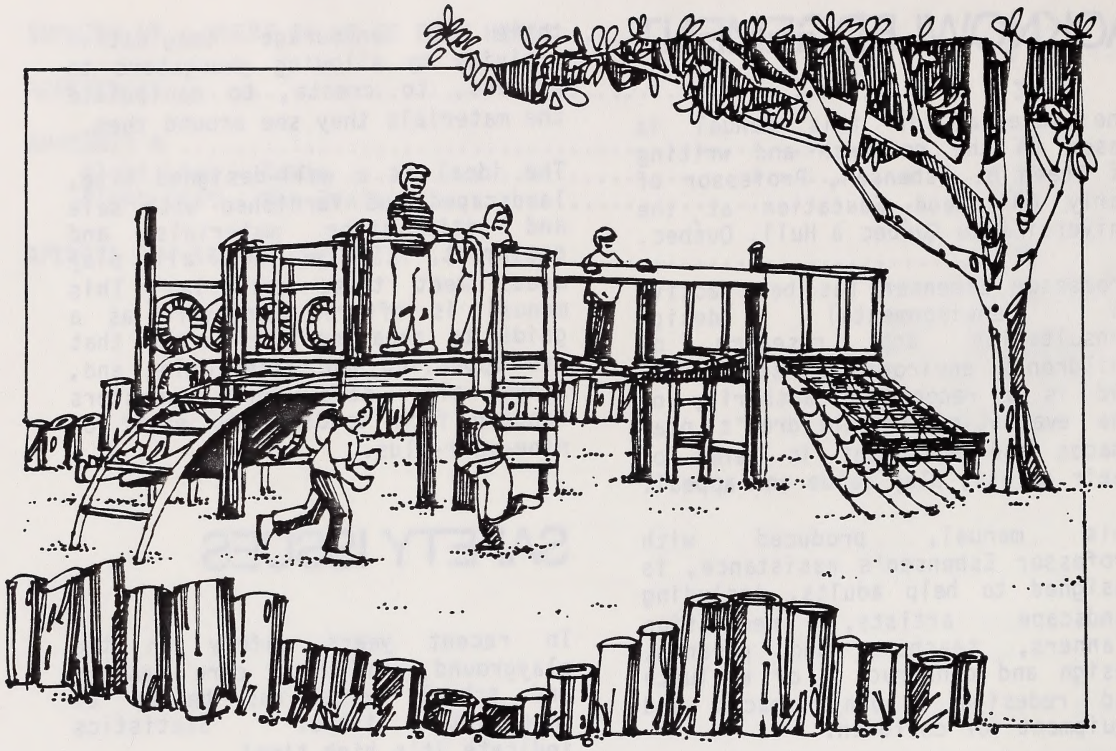
In recent years safety on the playground, in child care centres and school yards has become an important issue. Statistics indicate it's high time!

For example, did you know that:

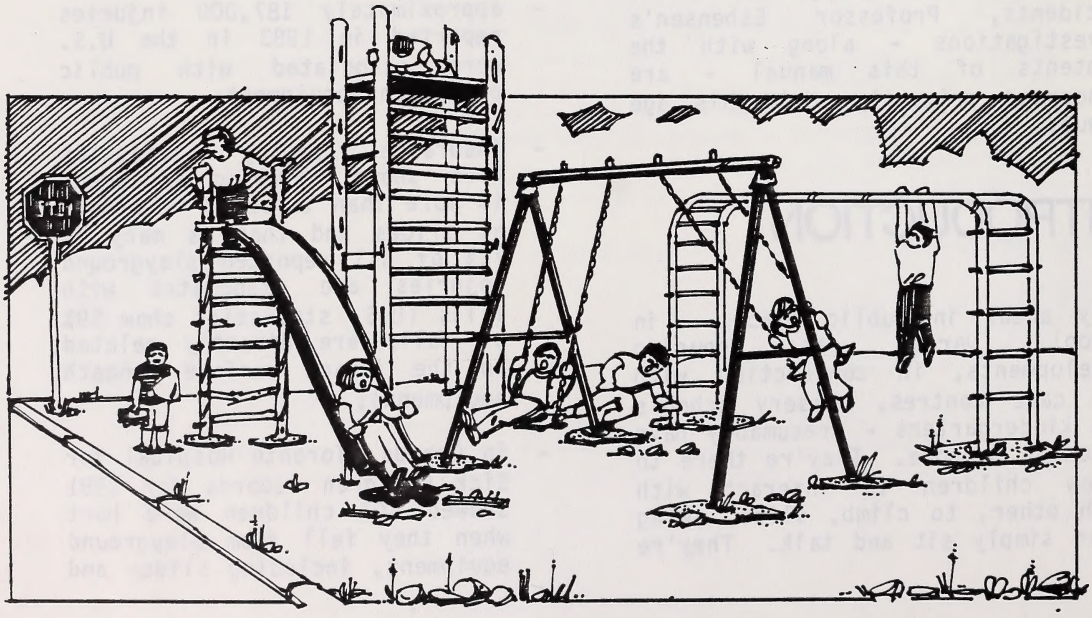
- approximately 187,000 injuries reported in 1983 in the U.S. were associated with public playground equipment;

- insurance company statistics have shown climbing equipment is more than twice as hazardous as slides and that as many as 72% of all reported playground injuries are associated with falls (U.S. statistics show 59% of falls are directly related to the impact surface beneath equipment);

- in Canada, Toronto Hospital for Sick Children records for 1981 showed 407 children were hurt when they fell from playground equipment, including slides and



Your Playground — Ideal...



...or Safety Trap?

climbing bars, were hit by swings or bumped by other playground equipment; and

- a three-month survey at Children's Hospital of Eastern Ontario found 5% of all visits followed accidents on playground equipment, 20% of which occurred at school and 55% of which involved accidents on monkey bars and climbing equipment.

Evidence of the problem continues to mount. In 1983, for example, Safety Canada statistics showed 14.8% of accidents occurred at recreation/sports locations and that accidents on swings, swing sets, monkey bars and playground apparatus were among the top 20 causes of injury.

The problem is not confined to North America. In New Zealand, the community of Dunedin reported 81 children between five and 18 admitted to hospital between 1974 and 1977 as a direct result of falls from playground equipment. Monkey bars and jungle gyms were involed in 61% of the accidents.

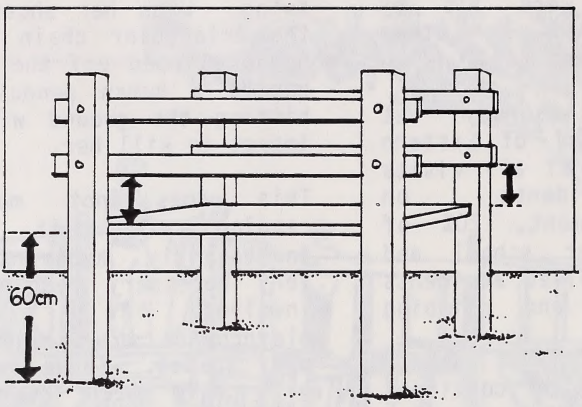
Such statistics are alarming when you consider that hundreds of playground accidents annually go unreported.

Too often, the statistics reflect true tragedies. Reports from around the world tell of the three-year old boy who died after falling off a 3 m-high traditional slide. A four-year old girl was hung when she attempted to crawl backward under the lowest board of a fence on a climbing structure. A second child was killed in the same manner. Elsewhere, a girl, 10, died following a fall from a swing. With her shoes wedged into the triangular chain brackets, her hands slipped off the chain and she became a human pendulum, her head hitting the ground with sufficient impact to kill her.

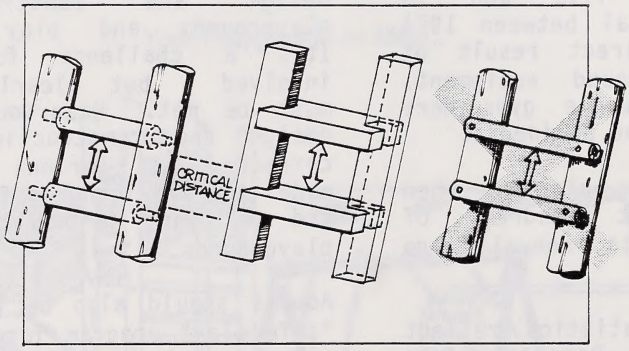
This does not make pleasant reading. But it is becoming increasingly apparent that it's very necessary reading for anyone involved in planning new playgrounds or evaluating existing play spaces. These tragedies might well have been averted if play areas and equipment had been designed with safety in mind, if manuals such as this had been widely available. Sad to say, many accidents are due to the negligence or ignorance of adults.

Happily, something can be done about the problem. At the very least, the frequency of common accidents can be reduced by applying available knowledge about design and construction of playgrounds and play equipment. It's a challenge for everyone involved - but clearly one that must be met. Hazardous equipment design and construction must be corrected and serious commitments made to providing safe materials and equipment in new or renovated playgrounds.

Adults should also be looking at a "safe play" program for children in schools and kindergarten, perhaps involving such agencies as safety councils, early childhood services and school boards.



Between 11 cm (4¼ in.) and 23 cm (9 in.) children can be hung because their heads will not pass through the opening. Two 4-year-olds have died due to this, as well as one 2½-year-old while an 18-month-old boy died when his head became entangled in a ladder where the distance between the rungs was less than 15 cm (6 in.).

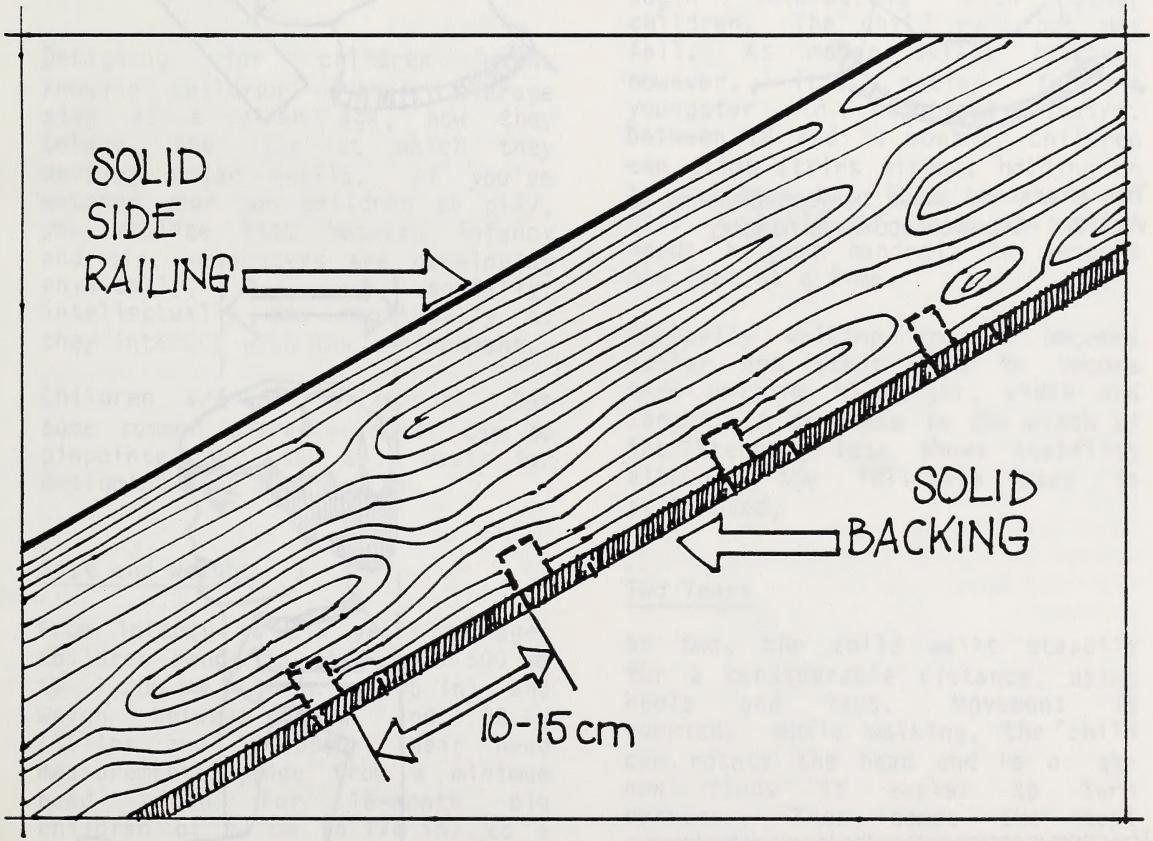


The space between the inside of the ladder rungs must be looked at depending upon the age and size of the children accessing the structure. Particular attention must be given to preventing head entrapments. Guidelines in the U.S. and standards in Britain and Germany vary.

The U.S. Consumer Products Safety Commission Handbooks on Playground Safety specify that the distance between steps, rungs and platforms of playground slides be no less than 18 cm (7 in.), therefore, leaving the space between 18 cm (7 in.) and 23 cm (9 in.) as a possible hanging point. The German DIN 7926 Part 1 on ladders states that the distance between rungs or steps must be equal and 22.5 cm (8¾ in.) ± 2.5 cm (1 in.)

DISCUSSION: if a young child's head breadth and length measurements are significant indicators of spaces in which the head can be trapped, then perhaps the German DIN 7926 standard is more consistent than the U.S. guidelines.

Obviously the one-year-old children will need closer spaces in order to climb up onto a structure. Therefore, solid backing incline steps may be a better solution. The distance between the steps can then be safely gauged for their step. (Standards vary between 10 cm (4 in.) and 15 cm (6 in.) for children under three years.



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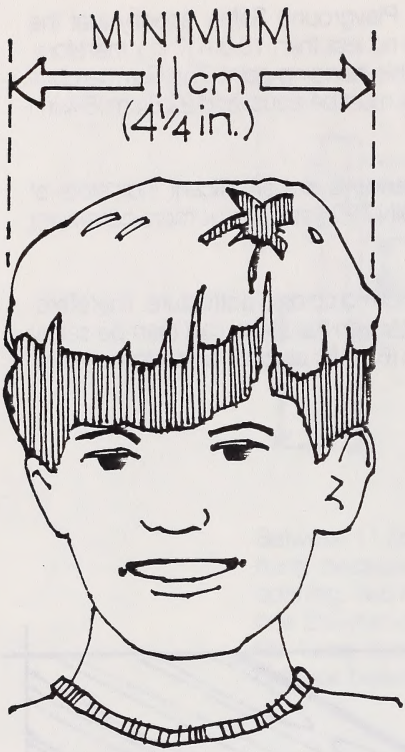
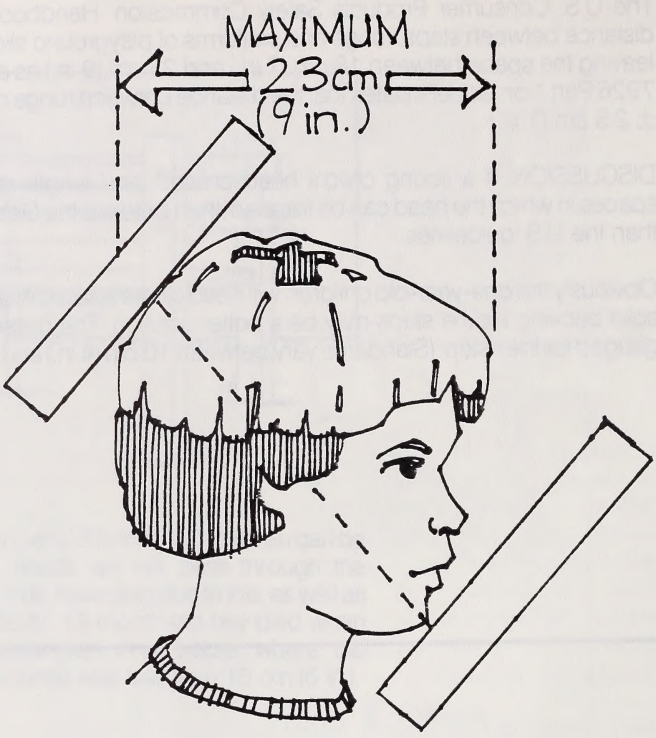




This is why the space between platforms is important - to prevent accidental hanging.

The chest is narrower than the length of the head, thus making body measurements important in the design and construction of playground equipment.

In the following pages, you will be presented with criteria for assessing the safety of play areas and equipment. These can be used to identify potentially hazardous design and construction details. And, most important, they'll help you make play spaces safe for young children.

First, you will need some background on the playground-users themselves.

CHARACTERISTICS OF YOUNG CHILDREN

Designing for children means knowing children - their average size at a given age, how they behave, the rate at which they develop motor skills. If you've watched your own children at play, you realize that between infancy and six, youngsters are developing physically, socially, intellectually and emotionally as they interact with the environment.

Children are all different. But some common characteristics can be pinpointed and used as a basis for designing safe play spaces.

Size and Weight

From infancy to six years of age, children range in size from 500 mm to 1,200 mm (20 in - 46 in) and weigh between 5 kg and 23 kg (12 lbs and 50 lbs). Their head measurements range from a minimum head width for 18-month old children of 11 cm (4 1/4 in) to a maximum head length of a six-year old child of 20.5 cm (8 1/6 in).

Motor Development Skills

Between 9 and 12 months, walking replaces creeping and there is a definite desire to stand upright. But even children who can walk, occasionally move around on hands and knees. First steps are short and erratic but, as balance improves, the stepping base widens and children become independently mobile as they learn to "stagger-walk".

Around 15 months, steps are longer, walking width is reduced and the child walks sideways and backwards. At this point, the child will begin using rocking equipment independently. Becoming more self-reliant, he or she will begin interacting with other children. The child runs but may fall. As motor skills improve, however, it's easier for a youngster to negotiate stairs. Between 18 and 24 months, children can climb stairs without holding on to railings but it's important to note a child of this age still needs a good handrail to descend one foot at a time.

Gradually walking upright becomes easier and steps tend to become more uniform in height, width and length. A decrease in the width of the stepping base shows stability although the full-sole step is still used.

Two Years

At two, the child walks steadily for a considerable distance, using heels and toes. Movement is hurried. While walking, the child can rotate the head and he or she now finds it easier to turn corners. Then comes the most outstanding achievement of this age - running. Even more complicated

than walking, running calls for accurate timing of the trunk and limb movements.

Between two and two and one-half, youngsters walk up and down stairs without support. When running, they can change direction on command. Still children at this age are not ready to avoid danger on their own. For example, perceptual skills are not yet sharp enough to allow for a change of direction when objects suddenly emerge. They also begin to climb up ladders using arms and legs alternatingly.

The two-year old, with encouragement, will jump from a height of 20 cm to 26 cm (8 in to 10 in) and maintain balance upon landing. But sliding can be different. It's not always possible at this age to maintain uniform balance on a slide and if the child's body is moving too quickly, it may fall backward.

Three Years

By the time the child approaches three, walking and running are routine. Balance is improved, feet are nimble and the child shows enterprise in attemping stunts beyond the ability of a three-year old. More persistent, more confident, more daring, the child is now enjoying good command of leg and foot movements.

Four Years

By the age of four, the child can pump with legs and feet, making the swing go while still maintaining balance and centre of gravity. Movements of different parts of the body are further mastered and co-ordinated. The four-year old obviously takes pleasure in stunts such as whirling, swinging and somersaulting.

The sense of balance is so well developed at four that the child can descend a long stairway by alternating feet - although handrails still come in handy. By now, the child runs smoothly at different speeds, turns sharp corners and can stop and go quickly.

Five Years

The five-year old can do all the things mastered at four - and do them much better. Motor skills are displayed with abandon. Less supervision is required and activities are now marked by ease, grace and economy of movement. Children at this age display a keen sense of balance and versatility in the use of hands and feet, all of which points to the next phase of childhood.

By this point, children can walk three metres on their toes without touching their heels to the floor. Steps are longer in both walking and running and speed of movement is better than it was at four.

Children at this age can skip with both feet, making running broad jumps of 71 cm to 88 cm (28 in to 35 in), run the 35 metre dash (about 38 yd) in less than 12 seconds, and kick a soccer ball 3 m to 4 m through the air.

At this age, too, children can climb and descend long stairways or ladders, alternating the feet. And they can negotiate a narrow balance board without stepping off more than twice.

While mastering motor skills at play, the young child is also becoming aware of objects and people in the environment. By now there is greater interest in social play as children seek out friends to join them in play environment activities.

At this point, you should be thinking about providing a background for four types of play.

Social Play

Play spaces and equipment for pre-schoolers should be designed to help them develop and refine their social skills, not only through language but also through non-verbal communication. Equipment that helps youngsters play house, shop, garage or train station, for example - or lets them imagine they're taking a boat ride to a far-off shore - can be extremely valuable, adding quality to their dramatic play.

Physical Play

Through their social interactions the motor development competence of young children is enhanced as they move around the play space. The overall site, play equipment and play materials will enable children to put their bodies in motion on different equipment; balance, swing, sway, climb, slide, pull and generally have a variety of motor experiences. The equipment should be scaled to enable the child to grow with the challenges provided by the equipment.

The physical play activities of young children (under nine) commonly happen through pretend or role-play activities on the playground. Swings can be quiet places from which to observe others at play while gently swinging back and forth. Likewise, loose parts such as plastic sand buckets, spoons and small containers brought to the playground, can support motor and social development of the children.

Creative, Cognitive Play

Young children are constantly testing what they know and recognize in the world around them. To help them satisfy their ingenuity and curiosity, pre-schoolers need environments which they can manipulate and substantially control. They need to be in charge. Sand and water, along with small toys such as boats, vehicles and miniature people, create such an environment. By combining commercially available props with found objects, they can create an imaginary village (or world) - and they can control it! Thus fantasy and experimentation merge. And together they help the young child grow toward mastery of the environment.

Quiet, Retreat Play

Sometimes, children need to retreat from the hustle and bustle of the play environment. For children growing up in a group day care setting, for example, the need to find privacy on the playground is now considered just as important as the need for social play opportunities. These youngsters need space and equipment that will let them sit quietly, observe and think about their day. The total development of young children happens in such settings where they can find environmental cues to enhance their social, motor, creative-cognitive and emotional development.

In order to plan, design and develop a safe and stimulating outdoor play and learning environment, some clear guidelines are needed - some sort of framework based on the developmental needs of children and environmental psychology.

Let's assume that on a municipal, school or housing development playground, adult supervision is only occasionally provided. Generally, it happens only when parents accompany their children to the site. This makes it even more important to choose the right location and materials and to design and construct the play space so that hazards to young children are minimized. At the same time, you want to provide stimulating play opportunities. Both goals can be achieved. In fact, a strong relationship exists between the site, the materials, the play value and the safety considerations for children.

Think first about the child. He or she is at the very core of this developmental design framework. It's crucial, therefore, to consider the child's level of physical, social, intellectual and emotional development. All of these factors dictate how sites should be laid out and the kind of play possibilities that should be provided.

Some points to remember:

- children under five need outdoor equipment and materials in proportion to their size and motor development;
- site layout, landscape variety, textural diversity and play equipment should all be aimed at creating the most stimulating play and learning environment possible - without threatening children's safety; and
- agile and increasingly social pre-schoolers need greater diversity of experiences in a safe and stimulating play environment.

By using this framework and the following criteria, you, as responsible adults, will be able to effectively assess playgrounds for young children.

The Role of Adults

The adult presence in the play environment takes many forms. It can be supplied in public parks by parents who accompany their

children to the playground, at school by a teacher or recess monitor who oversees activity areas, in early childhood education programs by adults who interact with children and provide a positive play and learning environment.

Whatever form it takes, this adult presence should be part of the picture. It determines the quality of experience available to children in play areas.

Adding up all of the elements then - the focus on the child, the importance of physical surroundings, and the role of the adult - we arrive at a definition of what an effective play space is all about.

The role of the playground is to provide a child-centred outdoor environment where interaction is enhanced by reducing the built enviromental hazards and enhancing the dynamic interchange between children and adults.

SITE ASSESSMENT CRITERIA

The location and size of the playspace you create - or redesign - will affect how often it is used and the quality of play that takes place there.

A safe and effective site should:

- be easily accessible to young children and their accompanying adults;
- be located so as to minimize disturbance to others;
- be located in an environmentally safe area, not adjacent to a major thoroughfare where exhaust fumes will be strong, nor close to toxic sites or industrial waste facilities;
- be accessible to maintenance equipment;
- provide for the four basic play categories - physical, social, creative-cognitive, and quiet retreat - as outlined in "Planning Play Space Opportunities for Young Children", Esbensen 1980;
- be large enough to accommodate a variety of play possibilities;
- maintain a scale and cozy quality which relate to the size of young children;
- encourage children to feel protected and to seek privacy as well as feel secure in public areas;
- provide a place for adults to sit;
- be enclosed to ensure that young children are protected from the automobile;
- have landscaping characteristics which provide some protection from prevailing winds;
- provide for sun and shade;
- provide a variety of landscape components and topography;
- provide a variety of colour, through the landscape and the play equipment;
- present a variety of geometric forms; and

- provide soft and hard surface areas to accommodate different activities.

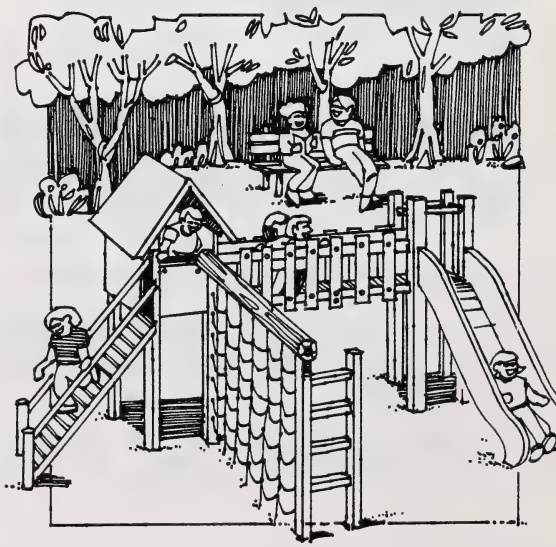
This is a partial list only, reflecting general considerations for ensuring satisfactory play value and safety qualities in your playground site.

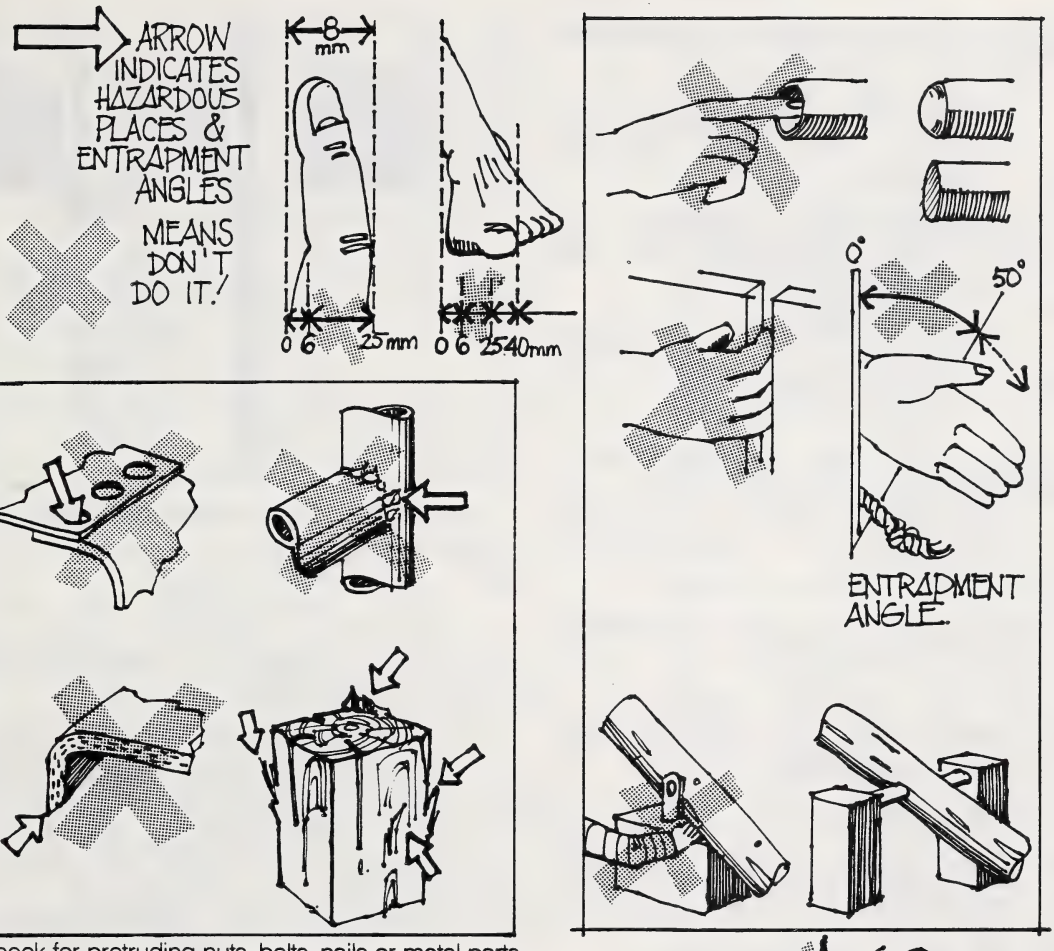
Equally important is the consideration given to the quality, play value and safety of playground equipment. Whether custom-built or purchased from manufacturers, this equipment will vary in terms of play value, safety and durability. In this regard, you should be aware that no standards currently exist in North America for the design, construction or security of built play components. Because of this, the following information is offered to parent groups, consumers and maintenance crews seeking guidelines for ensuring the adequacy and safety of built playground equipment for specific projects.

MATERIALS ASSESSMENT CRITERIA

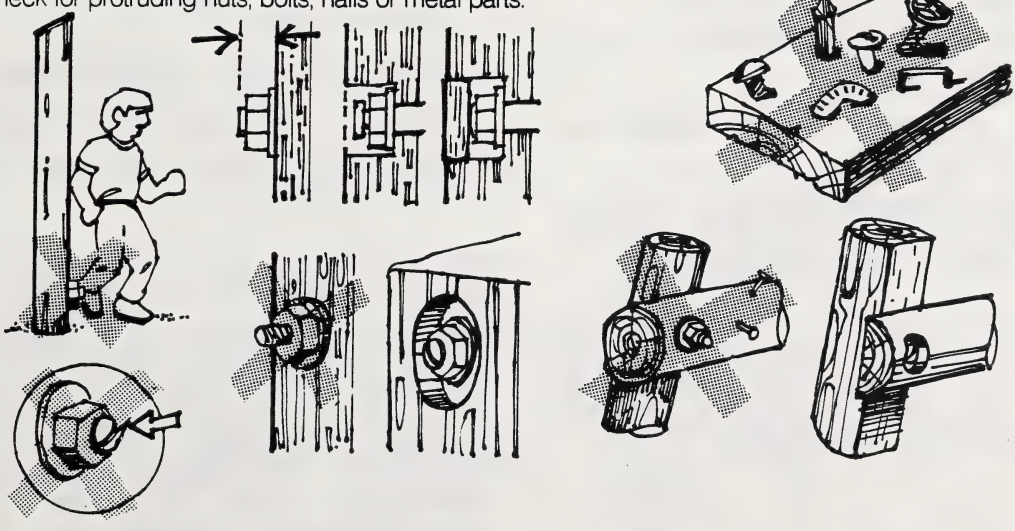
Playground equipment for children up to nine years of age, should:

- complement the overall site and the environment in which it is to be placed;
- provide play value compatible with the zone in which the equipment is placed;
- provide colour to supplement the natural beauty surrounding the play space;
- be scaled to the size of young children;
- have access to higher levels which are challenging and safe;
- have slides at heights which correspond to the size and age of the child;
- provide swings and seesaws constructed in such a way that even very young children can easily play on them;
- be well finished and have smooth corners to eliminate splinters and cuts;
- be smoothly finished with no protruding elements such as bolts or steel rods that might cause injury to the children;
- be placed on a surface which has a relatively satisfactory shock-absorbing quality;
- be positioned to avoid collision between pieces of equipment - and children; and
- have adequate railing to prevent accidental falls.





Check for protruding nuts, bolts, nails or metal parts.



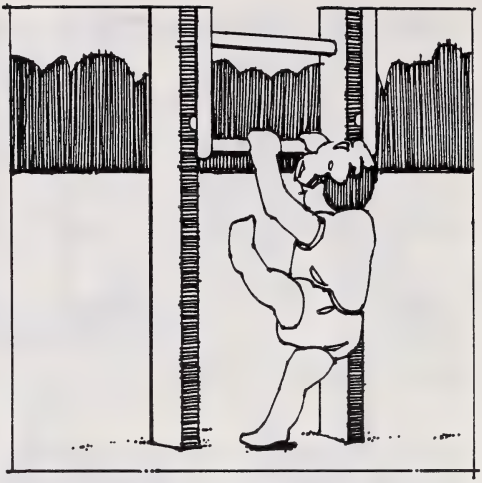
Bibliography — Richter, J., **Sicherheit auf Kinderspielplatzen**, Munich 1981.

Slides and climbing structures should:

- be in scale with the age of children for whom it is intended;
- be varied and challenge the child to concentrate on the activity of climbing;
- provide arms and legs with co-ordinated movement to challenge the whole body;
- avoid the use of only simple stairs which do little to challenge the motor integration and co-ordination skills of the child;
- use ladders as a way of getting up and down;
- be safe so that children have good balance and grip as they climb up and down;
- bring the child to a resting (transition) space which is safe and relaxing before he/she undertakes the next adventure; and
- be free of protruding nails, nuts or bolts.

When choosing ladders, remember the following:

- rungs should be about 22.5 cm (8 3/4 in) ± 2.5 cm (1 in) apart to allow easy grasp;
- rung size should be about 40 mm (1.5 in) in diameter, allowing the child's hand to enclose more than two-thirds of the rung's circumference;



Remove bottom rung of tall slide so preschoolers can't climb up.

- the bottom rung of tall equipment should be removed so that smaller pre-schoolers can't climb up;
- ladders should be solidly anchored to avoid unpredictable jerky movements while the child is climbing and should be placed at an angle for heights greater than 1.35 m (4 ft 5 in) since vertical ladders require a more awkward climbing posture; and
- design of the ladder should prevent fingers from becoming pinched in between a rung and a platform (or a rope and a platform).

Climbing Structures

We have looked at design considerations which apply to all equipment on the playground site. The next step is to examine design criteria that apply to specific structures or play equipment components. First, it's important to realize that children love to climb and that climbing can mean falling. Climbing structures

should always be placed over sand or an equivalent impact surface to soften falls in the case of accidents. At the same time, careful design and construction will minimize the chance and frequency of such accidental falls.

Where children are 80 cm (31 in) or more off the ground, structures should have:

- protective sliding corresponding to the age and size of the children (i.e., for 1-3-year olds, around 60 cm (24 in) high);
- safety bars at platform heights to prevent children from falling off;
- solid sliding or vertical boards to make climbing on the siding impossible;
- no horizontal bars which allow children to climb higher than the planned height;
- safe and scaled ways of getting from one part of the structure to another;
- a good hand grip with rung diameter around 3.5 (1.5 in) to 4.5 cm (2 in).
- no protruding metal parts, nut, bolts and nails; and
- smooth and rounded corners, when made of wood.

When planning and building climbing structures, remember they should:

- be thoughtfully designed so that incompatible activities are avoided;
- be designed so that a slide and ladder are not placed parallel to each other, eliminating the chance that children will jump from ladder to slide;
- not have horizontal ladders above or adjacent to a slide, avoiding the possibility of a child on the ladder swinging his feet down into the body of a sliding child;
- not have open platforms adjacent to a swing;
- have a soft surface such as sand underneath the equipment;
- offer predictable and appropriately scaled access;
- be inspected to ensure boards and enclosure bars will not allow children to get their heads or arms stuck between them (openings between 11 cm (4 1/4 in) and 23 cm (9 in) can be fatal head entrapments); and
- be built to reasonable heights, recognizing that 2.5 m (8 ft) for a child may well be the equivalent of 7.5 m (25 ft) for an adult.

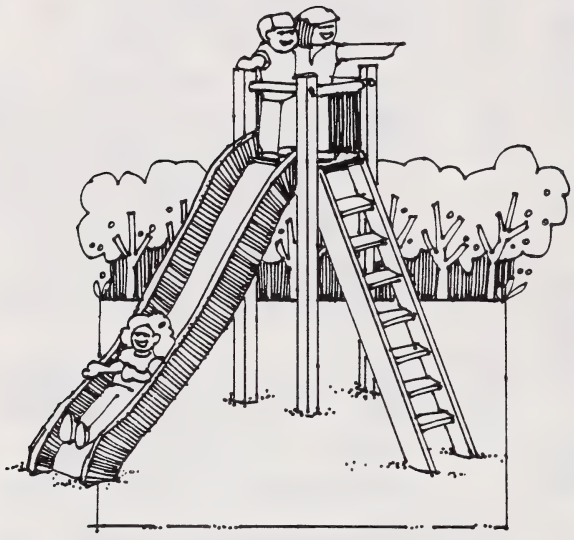
A Word About Nets

In the event that rope climbing nets (or suspension nets) are used, they must be firmly connected, using devices that cannot cut a child.

Slides

Slides can be designed safely to enable children to slide from great heights, alone or with other children. Slide types differ widely and the following recommendations therefore apply generally to all forms of slides.

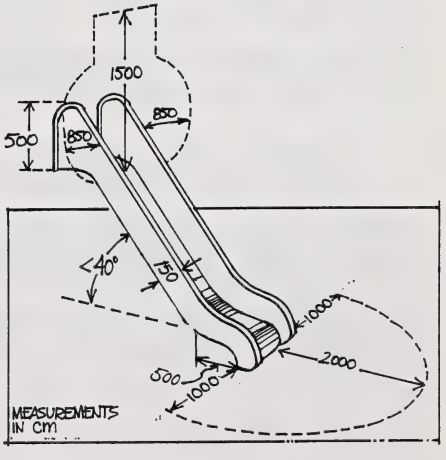
Construction Features



Slides should have enclosed debarkation platform

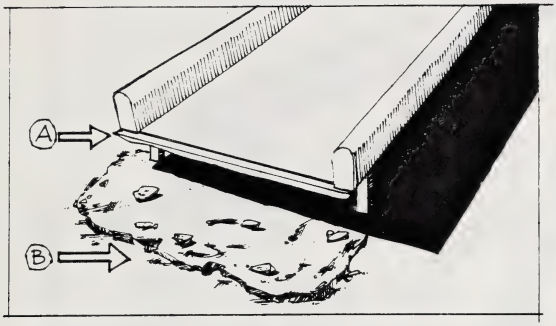
Slides should have:

- an enclosed debarkation platform, making it virtually impossible for a child to fall;
- side screening about 8 cm (3 in) to 15 cm (6 in) high to prevent chidren from rolling off;
- a run-off lip at the base to create a smooth stop without a sudden impact to feet or back;
- a support plate to the run-off lip which is wrapped underneath the sheeting, thus eliminating sharp edges or joints from the slide;
- single sheet stainless steel construction where possible, with longer slides requiring careful construction to eliminate the chance of metal cutting children (fibreglass slides require extensive maintenance as abrasive sand wears down the surface of the slide to expose glass fibres which can then become hazardous splinters for hands or legs);
- no metal bolts or other sharp construction braces visible on the sliding surface or inside the side-screens;
- a barrier to encourage sitting on the slide rather than walking or running down;
- a slope which will provide speed without endangering the child; and
- a safety zone measuring 3 m x 6 m (10 ft x 19 ft 8 in) which means it will extend 2 m (6 ft 6 in) beyond the debarkation lip.



A Safe Slide
(Measurements from DIN 7926)

Some Additional Considerations



A A hard blow to the back.
B A punishment no child deserves.

- slides should never be positioned in open areas with southern exposure since surfaces will often be too hot for comfort;
- they should be embedded in an embankment with about a 40 degree slope, and with a peak large enough to accommodate several children at once;
- slides should never descend in a direction where children are at play; and
- electrostatic shock from some sliding surfaces, i.e., fibreglass, have reportedly contributed to dizziness, malaise and nausea among 2-5-year old children in day care centres.

Tunnels, Tube Slides and Spiral Slides

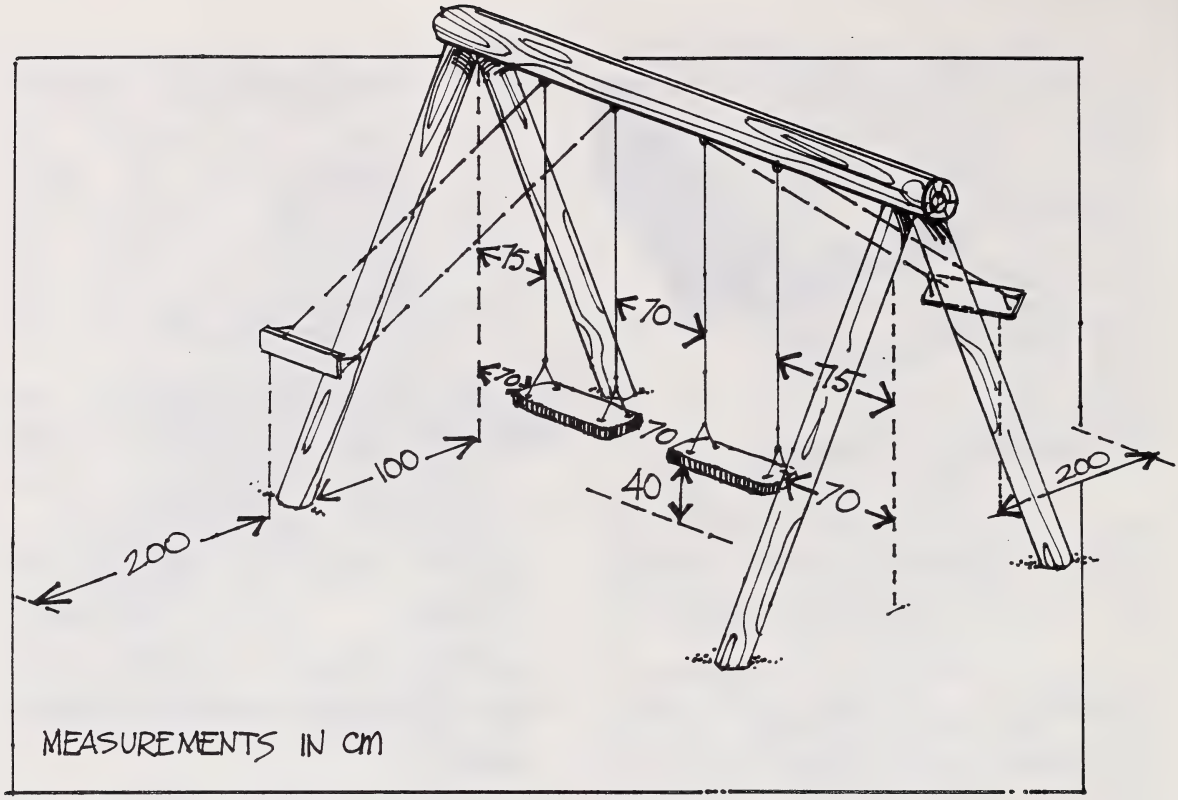
While the above applies to slides in general, tunnels, tube and spiral slides call for special consideration. For example, spiral slides pose serious problems in terms of head clearance, spacing next to structures, side supports and final deceleration platforms. To be certain such structures are safe for children, you should ensure they will not bump their heads on any object 1,500 mm (6 ft) above the sitting surface. You will also have to be certain that siding and descent platforms meet previously stated criteria.

Tunnel slides are generally very sensitive to safety although concerns can arise over the angle and landing strip, which is often very abrupt. There is also a danger that children will decide to use the top outside surface of the slide, putting them in a very hazardous situation. Also, remember that, for the young child, the joy of seeing a smiling parent or friendly teacher while sliding, is eliminated when sliding in a tunnel.

In cement tunnels, which have been used for decades, the concern is to provide a soft absorbing surface at the two ends to prevent concussions.

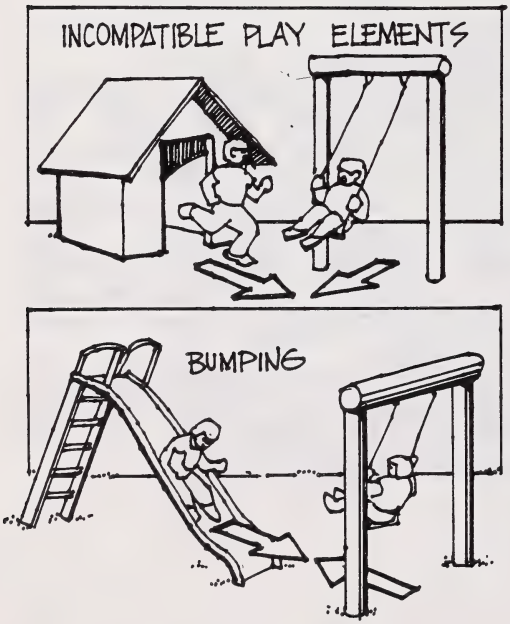
Swings

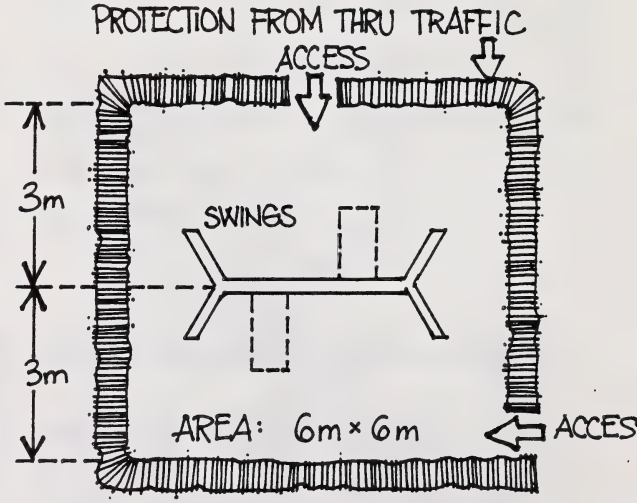
Swings have undergone a tremendous evolution during the past two decades. Wooden swing seats, so popular on backyard trees a decade ago, are now replaced by absorbent rubber tires, plastic or strap seats. In each case, the hardware used to make swings is not the only element which helps to make a swing set safe. The framing and surrounding play components are also important. The following apply to the swing set and its surrounding area.



DIN 7926 measurements

Swings hung 70 cm (27½ in.) apart help prevent side-sway bumping. No more than two seats should be attached to undivided frame and swings should be no less than 70 cm (27½ in.) from support and beams. Swing seats should be around 40 cm (16 in.) off the ground.

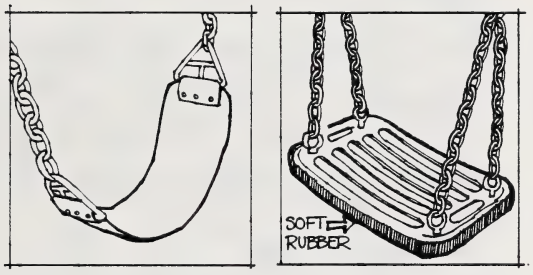




Construction Features

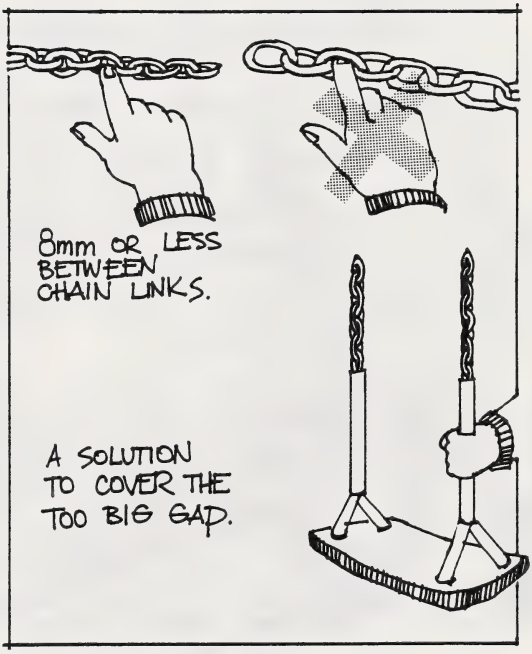
Swings should have:

- A-shaped supports;
- no more than two seats attached to an individual frame to minimize bumping accidents;
- seats hanging side by side which should be used independently and be far enough apart to diminish side-sway bumping (minimum 70 cm (27.5 in) apart);
- clearance between any part of a swinging assembly and the frame of no less than 70 cm (27.5 in);
- seats with a ground clearance of not less than 35 cm (14 in) when in use and a seating surface of not less than 45 cm (17 in) or more than 63 cm (25 in) above ground level;



Swing seats should be made of impact-absorbing materials.

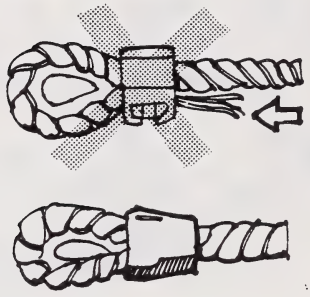
- seats constructed of impact-absorbing materials, or having impact-absorbing surfaces on all contact areas;
- no wooden or steel seats;
- no steel-belted radial tires with steel bands that can eventually poke through and cause serious injury - if in use, inspect frequently;
- drainage holes punched in tire swings to eliminate water and keep tires from freezing in cold weather;
- white painted interior (in the case of tires) to discourage poisonous spiders from nesting (southern climates);



Short-linked chains save little fingers.

- in the case where seats are suspended by chain, a "mild steel chain grade 30 short link and pitched or calibrated for lifting purposes", recommended B.S. 5%; and

- reliable fastenings on suspension mechanisms which can be secured against unauthorized loosening.



Additional Safety Considerations

- swings should be located in an area where the danger of a person being hit is minimized (i.e., an area of 6 m x 6 m (20 ft x 20 ft) clearance should be maintained and should be 3 m (10 ft) from the fulcrum in either direction);

- a hedge or low fence surrounding the swings can prevent small children from running into the path of a moving swing;

- never place a single-point swing side-by-side with another kind of swing;

- with one-point pivot swings, be sure the swing never hits solid support - clearance is critical to avoid bumping accidents; and

- check support beams, suspension brackets, seats and impact surface for wear or poor maintenance.

Paints and Finishes

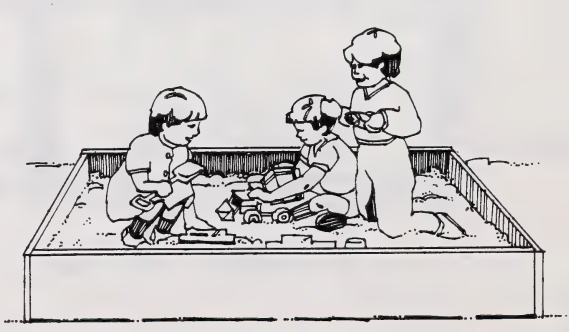
Playground planners must satisfy themselves that paints used on playground equipment are absolutely non-toxic.

Other finishes should have the same non-toxic quality and wood preservatives should conform to accepted standards. As well, the equipment should be designed so that the direct climbing posture of small children minimizes contact with wood preservatives which may be toxic. The potential hazards presented by pressure-treated wood is currently a matter of debate. Until study results are finalized, therefore, it is questionable if playground structures should be built exclusively of pressure-treated woods. Other wood types, containing no potentially toxic preservatives, could be substituted for those components which children hold onto with hands and arms.

Sand

Two kinds of sand are recommended for use in playgrounds - sand for sandboxes or sand areas, and impact sand which is used under climbing equipment, swings and similar structures, likely to cause falls.

Sandbox Sand



In a sandbox or similarly designated sand area, children use sand to make forms, tunnels, roads and whatever else their imaginations dictate. The sand you choose for this area, therefore, must hold together when moulded. Otherwise, it will only frustrate the children at play.

The sand should:

- pack well when moist, maintaining the shapes made by the children;
- be a balanced mixture of particle sizes, ranging from coarse sand of preferably not more than 1.5 mm (1/16 in) to very fine sand;
- resemble seaside sand or a well-washed sand of the above mixture; and
- be clean and free of clay, silt, oxides, iron or other contaminants.

A good depth of sand in the sand area is between 38 cm and 45 cm (15 in and 18 in).

A Safety Test for Sand

Before accepting delivery of sand, test it by placing a sample in white cloth to see if the damp sand stains or discolours it. Discolouration or stain indicates the sand has not been sufficiently washed and will not be effective sandbox sand.

Also pay particular attention to the presence of any sharp materials such as artifically crushed stone. Such material can cause cuts and minor skin irritations and can be potentially dangerous to the eyes.

Maintenance

Sandbox or sand-play area:

The sand in the sandbox should be raked over regularly to remove all surface debris. Special care should be taken to remove broken glass, plastic and rusty cans, along with fecal matter from animals.

In high-use urban areas, sand should be given a treatement with chloride approximately once a week - more frequently during summer months.

The recipe for sandboxes calls for:

- 220 ml fluid chloride of lime to 18 L of water for each 10 cubic metres of sand;
- 1 - 9 L bucket; and
- 1 - 9 L watering can.

Directions:

Fill the 9 L bucket and the 9 L watering can with water, add 110 ml of fluid chloride to each container and stir well with a stick. Use the watering can to distribute the solution over the sandbox, refilling it from the bucket. More equal distribution of the disinfectant mixture by the watering can assures better maintenance.

After applying the chloride solution, hose down the area to allow the solution to penetrate the sand. Once you're sure the disinfectant has penetrated the sand, turn it over one shovel - 19 cm (7.5 in) - deep before the children use it again. Once this is completed, the children can resume their play in a clean, bacteria-free sandbox.

Some Words of Caution

Your attention to maintenance can increase the life of the sandbox and the health of your children. Therefore, the following guidelines are worth following:

- be sure to mix the disinfecting materials thoroughly with the sand;
- avoid excessive hosing of the sandbox as it will cause waterlogging and penetration of decaying vegetable matter such as leaves;
- be sure to turn the sand over periodically to its full depth; and
- remember to change the sand when it shows signs of becoming excessively dirty and unmanageable.

Impact Sand

Impact sand is used under climbing equipment, swings and similar equipment where falls are possible. The primary purpose is to cushion and absorb a fall. It's important therefore to choose sand which doesn't pack together to become a hard surface. The quality of impact sand is essentially the opposite of sandbox sand. Wind-blown sand of the type found in sand dunes is an excellent example of impact sand. It consists of rounded particles of uniform size which move easily against each other, and thus yield when hit by an object or a child.

Dune sand has one obvious disadvantage. When dry, it blows around with the wind. This problem can be overcome, however, by enclosing the sanded area by a hedge or similar windscreen.

Because dune sand is very difficult to obtain, sand with particles of 1.5 mm to 0.25 mm is recommended, providing the particles are not so abrasive as to cause damage to a child's skin.

Another alternative to consider for impact purposes is small gravel or finely crushed rock - and again, you should check for abrasion and compacting hazards. Whichever sand or particle material you decide to use as impact surface, be sure to provide a minimum depth of approximately 30 cm (12 in) to ensure sufficient absorption.

Maintenance of Impact Sand

Maintenance consists essentially of three common-sense steps:

1. Keep the impact sand free of dirt, broken glass, weeds and debris.

2. Turn the sand regularly with a pitchfork, especially in heavily used areas where sand tends to become compressed and as hard as asphalt.

3. Add sand when it seems to have settled or blown away.

Landscape Materials - Hedges, Bushes and Plants

While plants contribute to the beauty and, as in the case of hedges, to the safety of play spaces, they can also present potential hazards. Some garden plants are naturally toxic at certain stages of growth and to certain children. They may have been treated with an insecticide which makes them toxic.

Some plant materials cause dermatitis when handled. You should consider, as well, that young children may be inclined to eat berries or buds off plants or bushes and that thorny or prickly shrubs used in hedges may inflict cuts or scratches.

Wild plants - including wild mushrooms and poison ivy - which are allowed to invade playgrounds, also pose a potential threat to children.

To help ensure that only safe plant materials are used in the play landscape, a list of toxic and non-toxic plants is included in Appendix A.

This information is offered as a general guideline only and further contact with local horticultural authorities or toxicologists can help you make the right landscaping choices.

Water Features

You may wish to incorporate a water pump or a pressure nozzle tap in the playground as a source of clean running water for mixing with sand. This is a good idea as long as proper drainage is provided.

Shallow ponds may also be considered, based upon location, access and the type of supervision that will be provided. In such cases, however, depth of water and

coliform levels should be of major concern.

Because of the many technical aspects involved in creating playground ponds which are both clean and safe for young children, this subject is dealt with in greater detail in material designed to guide landscape architects and recreation and parks planners.

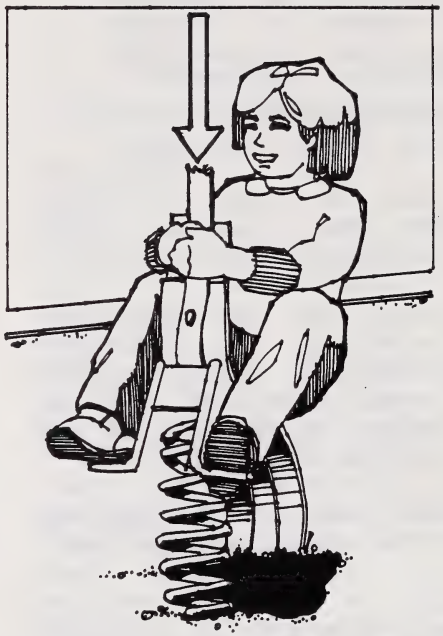
Surfacing

In recent years a variety of materials has been used as surfacing under playground equipment. Sand, gravel, granulated pine bark, rubber matting and shredded rubber all have a relatively satisfactory shock-absorbing ability. However, they must be used selectively to achieve a safe play surface around the playground equipment.

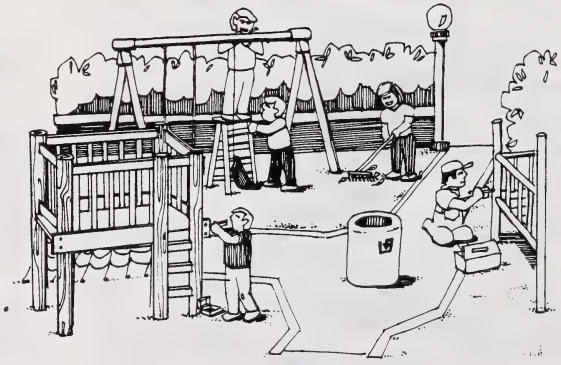
Research has shown the maximum height from which a young child can fall head-first onto different impact surfaces before sustaining concussion. This critical limit is expressed as 50 G (where G stands for gravity). The U.S.-based Franklin Institute Research Laboratories have undertaken comparative tests concerning the relationship between surface materials under playground equipment, height of fall and G-effect.

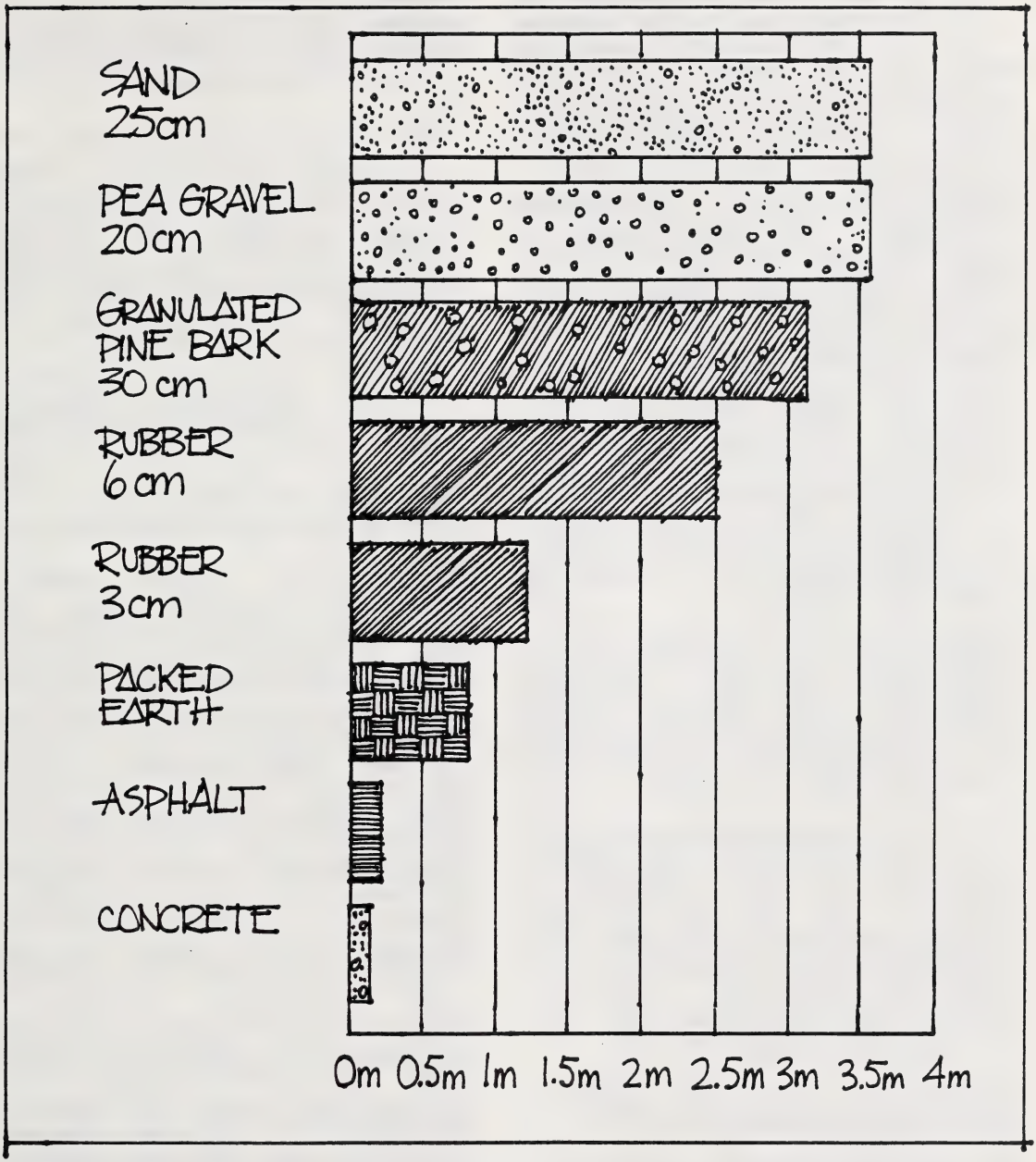
MAINTENANCE

The playground is the outdoor learning environment for a school, day care centre, recreation centre or neighbourhood. It's an important place - a place where learning opportunities in a play setting complement those in the classroom. But for the environment to be effective, it must be well maintained. Combined with good design and proper furnishings, careful maintenance will make it a good place for children and adults to enjoy each other.



AN EXAMPLE OF HAZARDS
Exposed spike is a real killer to the neck/throat part of the child.





The scale across the bottom indicates the height a child would have to fall to sustain concussion on each of the impact surfaces shown.

Maintenance is just as important to the playground as it is to the classroom, the community centre or the learning materials. In the indoor environment, floors are swept and waxed, furniture dusted, toys washed and loose carpets checked for potential slippage. Unfortunately, playground maintenance is rarely taken as seriously. All too often we assume that, because it's outdoors, there is not need to rake the sand, sweep the hard surface areas or trim off sharp branches in the playground. Think of the playground as the "outdoor room" for play and learning. Then you will be in a position to identify and remedy the causes of some accidents such as slippage on sandy asphalt surfaces or injury from falls to compacted sand at the base of a slide or underneath a swing.

Regular care and inspection of the landscape, furniture and play materials also provide a good opportunity to involve the children in learning to care for and appreciate their environment.

In order to ensure the outdoor play environment is kept in good working order, you may want to refer to the checklist at the end of this manual. Remember that each play environment is unique and you will have to assess your space for special features which are not included in this booklet.

However, it is a useful guide to look at the following:

1. Surfacing
2. Landscaping
3. Play Zones
4. Equipment Design
5. Equipment Construction
6. Equipment Placement

Remember, the quality of your environment is determined to a great extent by the attention given to its care and upkeep.

You now have a preliminary guide for assessing playground equipment and its location on a site. With this list, you can systematically review play spaces in child care centres, school yards and municipal parks to determine whether the equipment is well-designed and constructed. This form of critical assessment can have an important spin-off. It can help playground designers and manufacturers become more critical of their products. This in turn could spark improvements that will help eliminate hazards on the playground.

The situation in 1983 - when the most common accident causes were falls from playground equipment, bad surfacing, incorrect scaling and methods of construction, along with lack of maintenance - will not remain stagnant. It appears obvious that the more attention adults give to selecting outdoor play furniture for children, the better children will be able to play. Ideally, the more critically adults look at potentially hazardous situations in playgrounds, the longer and safer children will play. And there are other implications. Investing in good outdoor furniture - playground equipment for young children which meets the criteria for good design and construction - will serve to diminish the cost of emergency health care as well as short-term and permanent disabilities.

By now you will see that playground planning is more than child's play. As a further illustration of how to use the framework and criteria contained in this manual,

consider this account by playground authority Steen Esbensen of an actual playground assessment.

NOTE: Since the following is offered as an illustration of points made earlier, it is suggested that the reader study this material only after the prior text has been read.

CASE STUDY

It was a beautiful day, sunny with warm gusts of wind, generally a great day for going out to play with the children. Off we went to the newest playground for young children in the city, the latest example of municipal care for young children and their families. We arrived with our bikes and found, to our surprise, bicycle racks right outside the fenced-in playground. Good news! The presence of bicycle racks and a fenced-in yard were a welcome change from other public playgrounds, where parents are constantly anxious for their child's safety, and bikes are usually left cluttering the yard.

As we walked and half-ran into the yard, the variety of textures - in grass, bushes, sand, trees, wooden structures, a metal swing set and asphalt surfacing for wheeled toys - became more and more noticeable. In fact, we formed a very favourable first impression of a "safe" playground for young children.

Hold on! Did I say "safe"? Perhaps we'd better reserve judgement until we take a more systematic look at the playground.

General Characteristics

The four wooden play structures built on the site are located in such a way as to provide minimal conflict between the kinds of play activities likely to occur on the site. For example, the largest playground structure is located in a corner, well out of the way of the seating area and sandplay area. However, smaller climbing structure with a slide for the younger children is located in the sand pit only 2.5 m (8 ft) from the sandplay table. The two other structures are quite unobtrusive and appear to provide some additional play opportunities.

Having thus introduced the play structures and their relationship to the overall site characteristics, I will deal only with the playground apparatus. Judgements will be made about safety, scale and the design quality as seen on the newly-installed equipment.

The Large Playground Space

Access

Essentially, there are two ways of reaching the first level of the platform structure. Primary access is provided by stairs wide enough to accommodate two children at a time. Usually, stairs provide children with an experience which is predictable. The distance between each step, the depth of the step and the railing combine to create an environment which is both predictable and safe. On this play structure the steps conform to these norms; however, the railings are not entirely in scale with the hand

grip of small children, nor is the railing placed at a correspondingly scaled height for the child. It is possible, therefore, that the smaller child could fall down onto the sand between the stairs and the railing.

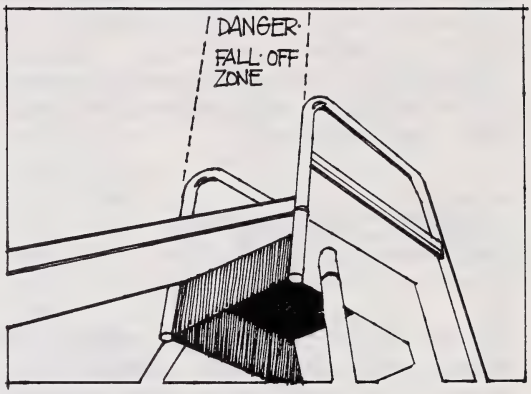
Children are also offered access to the first platform by a chain ladder attached vertically to the upper horizontal enclosure bar. The chain ladder has rungs which measure over 10 cm (4 in) in diameter and are therefore too massive for the grip of a pre-school child. The galvanized steel chains are also an additional hazard for small children who may pinch their fingers when holding them.

Access to the upper level is more difficult, suggesting that only the more physically adept child would be able to climb 185 cm (6 ft) above ground level. One would therefore also assume that the physically competent young child is safe on the top platform. However, the child who reaches the top has to be not only physically competent but also mature enough to know not to climb the horizontal boards enclosing the platform. If the child were to climb onto the boards, he could fall more than 2 m (6 1/2 ft).

Descent

Once children have reached the top platform, they have two options for getting down. They can jump down to the first level and potentially collide with other children, or slide down the two-person slide which faces due south and is so hot that children in shorts are unwilling to use it more than once.

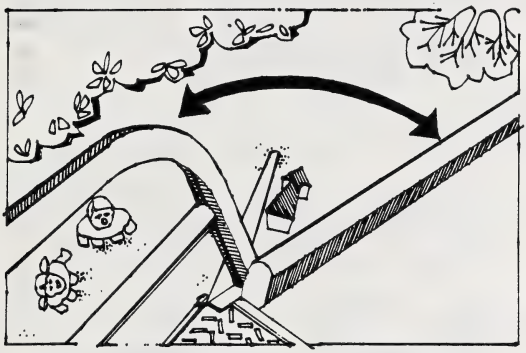
Slides



At the slides we encounter a design detail which is a common hazard on playground - the point of debarkation from the platform. There are no protective grips or railings for young children getting ready to slide. The absence of such design features makes the slide a potentially dangerous item on the playground as children can easily fall from the platform. This fault also applies to the tot slide which is attached to the smaller playground structure on the playground. On the tot slide a galvanized flat-head nail protrudes from a board right before the beginning of the slide.

These design and construction flaws illustrate how poor attention to detail in design and construction makes playground equipment dangerously unpredictable for young children. Some countries have already come to terms with the problem by establishing playground

equipment standards. These standards, in West Germany for example, require slides to have a protective design to keep small children from losing their balance and falling forward or sideways.



A potential killer.

The slide should provide children with a thrilling experience which they will want to repeat without fear. The lip extension on the slide is therefore as important to the slide as is the take-off. The lip detail on the slide in this park is much improved over the types of slides still dominating municipal and school playgrounds throughout North America. However, a small child may still fall backward and hit his/her back on the existing lips of the two slides.

A safer design would have the lip descend in such a way that the child would fall back upon a smooth brace rather than a blunt point. These safety details are still difficult to find on slides for young children.

Transition Structure

The rocking bridge structure is positioned to act as a transition between the taller climbing structure and the tot structure. Unfortunately, the children have to step up 44 cm-46 cm (17 in-18 in) to reach the sway bridge and, in so doing, they have to avoid scraping their legs on eight exposed nuts and bolts on either end of the bridge. These fixtures protrude 2 cm to 3 cm (3/4 in to 1 in) from the beam and demonstrate how poor detail can cause accidents among young children.

Social Playhouse

The house on stilts is 34 cm (13 in) off ground level and is therefore far from being comfortable for a two-year old. The horizontal bench seat which is 49 cm (19 in) off the platform level is "quasi comfortable" for a child 10 years of age or older. Younger children cannot comfortably sit on the bench with their feet firmly on the ground, and therefore find the structures uncomfortable and uninviting. The horizontal bar at the end of the house is 84 cm (33 in) above the floor level and thus raises serious questions about its safety. The average two-to-four year old child is likely to knock his/her head on this beam rather than perceive it as a barrier which provides a little privacy.

Swings

In this redesigned site, the swing frame is the only piece of equipment remaining from the previous playground. The metal frame is located in an area which initially appears to be out of the way. However, children running down the stairs of the large climbing structure risk running directly into the path of swinging

chidren. This area needs to be enclosed by a hedge as stipulated in the criteria section.

So much for first impressions! When all the details are reviewed, we find the site is not so favourable after all. Unfortunately, this is not an isolated case. The flaws cited apply to the majority of structures found on many playgrounds for young children.

Other hazards include: exposed nuts and bolts evident at lower leg levels and at eye/head level underneath the large climbing structure, and protruding metal bolts located precariously close to the debarkation platform on the slide.

Flat-head nails are seen working their way out of the boards on the tot structure as well as on the social playhouse, where the roof appears to be coming apart due to warping wood.

Our playground visit had turned into a valuable learning experience. We saw that a playground's use is ultimately dependent upon the quality of the site and materials. The design and construction detail given to the space and to the equipment will affect the frequency and kind of use made of the playground. In further reviewing this play space, adults were asked how they felt about the park. Generally, all found the park very attractive and a good improvement to the neighbourhood. Not one of them, and all were parents, had noticed the flaws identified in this assessment. While none of the items identified is serious in itself, the overall impact of these playground flaws is alarming and raises serious concerns about the hidden hazards on the playground for young children.

SUMMING UP: WHERE DO WE GO FROM HERE

In the design of playgrounds and equipment to meet the developmental needs of children at play, society needs to recognize the impact of adults' lack of knowledge. The most dramatic effects are the health and safety hazards confronting children on poorly-designed and constructed playgrounds as exemplified by this case. Hopefully, the information provided in this document, will:

- help parents and teachers of young children become much more aware of the hazards;
- encourage manufacturers to become more sensitive to the design criteria; and
- prompt parks and recreation developers to be more careful in their selection of equipment, in installation and in maintenance.

Over time, such attention to details will help reduce the number of hazardous playgrounds and make the playtime of young children safer and more stimulating.

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APPENDIX A

PLANT LIST TOXIC

Garden

Azalea (azalea indica)
Bleeding Heart (dicentra formosa)
Calla Lily (zantedeschia aethiopica)
Carnation (dianthus caryophyllus)
Castor-oil plant (ricinus communis)
Chinese or Japanese Lantern (physalis)
Chrysanthemum
Clemantis
Crocus (colchicum autumnale)
Daffodil (narcissus)
Dahlia
Delphineum
Foxglove (digitalis purpurea)
Gladiola (bulb)
Hyacinthe (hyacinthus orientalis)
Iris
Jonquil (narcissus)
Lily of the Valley (convallaria)
Morning Glory (ipomaea tricolour)
Narcissus
Pansy (seeds) (viola tricolour)
Peony (root) (paeonia officinalis)
Primrose (primula)
Sweet Pea (lathyrus odoratus)
Sweet William (dianthus barbatus)

Vegetables

Potato (green patches on tubers and above ground part)
Tomato greens
Rhubarb leaves

Hedges and Bushes

Black Locust (robinia pseudoacacia)
Buckthorn (rhamnus cathartica)
Caragana
Cherry Laurel (laurocerasus officinalis)
Daphne (daphne mezereum)
Elderberry (not berries)
Horse Chestnut (aesculus hippocastanum)
Hydrangea
Laburnum (laburnum anagyroides)
Privet (ligustrum vulgare)
Virginia Creeper (ampelopis brevipedunculata)

Unidentified Wild Mushrooms

Should be considered toxic until identified by a mycologist.

PLANT LIST NON-TOXIC

Garden

Aster (callistephus)
Begonia
Fuchia
Forget-Me-Not (myosotis)
Geranium (pelargonium)
Gloxinia (Tinningia speciosa)
Hollyhock (althaea)
Impatiens
Lily - Easter (lilium longiflorum)
- Tiger (lilium tigrina)
Petunia
Phlox
Rose
Snapdragon (antirrhinum)

Hedges and Bushes

Bongainvillea
Hawthorne (Haws) (crataegus)
Honeysuckle (lonicera spp)
Lilac
Mock Orange (philadelphus, pittosporum tobira)
Spirca (astilke japonica)

APPENDIX B

SAFETY CHECKLIST

Before turning over a new play space to your children, check the following to be sure you are offering them a safe, secure and stimulating environment in which to play.

1. Surfacing

   - Have you incorporated both soft and hard surface areas to accommodate different activities?

   - Have you used sand or equivalent impact-absorbing surface below climbing structures, swings and other equipment where falls could occur?

   - If using sand, have you placed it in sufficient depth - 30 cm (12 in) - to effectively absorb the shock of a fall?

   - If using other impact absorbing materials, have you checked their efficiency against the Franklin Institute Research Laboratory guideline on page 27?

2. Landscaping

   Does the landscape on the site:

   - provide protection from prevailing winds?

   - provide for sun and shade?

   - add variety and attractiveness to the site?

   - contain only safe non-toxic plant materials?

   - act as an effective barrier - in the case of hedges, for example - to protect children from being hit by swings, etc.?

3. Play Zones

   - Have you created areas which allow for distinct types of play, including:

     - social play
     - physical play
     - creative, cognitive play
     - quiet retreat play?

- Have you designated distinct zones for younger children's activities in which they are not threatened by activities designed for older children?

4. Equipment Design

- Is the equipment you have built or chosen designed to ensure that incompatible activities are discouraged?

- Is it designed to "fit" the children for whom it is intended to ensure both their safety and their ability to grip rungs, negotiate steps, etc.? (See Criteria, pages 14-22.)

- Have you taken measures to discourage smaller children from using larger structures beyond their ability, e.g., by removing lower rungs from ladders?

- Is all equipment sturdy, with ladders, swings, ropes, nets, etc., safely designed and securely anchored or fastened?

- Does equipment have adequate safety bars, siding, platforms and railings as well as barriers on slides, for example, to encourage sliding as opposed to walking down.

- Does equipment offer safe links and resting places between adventures?

- Have you checked criteria to ensure all slides, swings, climbing structures, tunnels, nets, etc., conform to recommended safety standards?

- Is the equipment imaginatively designed to ensure it will have good play value?

- Does equipment challenge children to use arms and legs and improve co-ordination?

- Does it offer a variety of play experiences?

- Is it attractively finished in a variety of colours and textures?

5. Equipment Construction

- Have you checked to ensure that all components of the playground are sturdily built, have smooth corners and no protruding element such as bolts, nails or steel rods?

- Are structures built to reasonable heights in relation to the size of the children who will use them?

- Are slides made from a single sheet of stainless steel as recommended and do they have appropriate and safe platforms, railings, and run-off features?

- Do swings have A-shaped supports, no more than two seats on an undivided frame, and proper placement in relation to ground and support structures?

- Are swing seats made of impact-absorbing materials such as rubber as opposed to wood or steel?

- Have recommended chains and fastenings been used?

- Does equipment have only non-toxic finishes?

- Is sand used in sand boxes and for impact surfaces of recommended quality?

6. Equipment Placement

- Is each component of the play space positioned to allow for safe access?

- Is there a safety zone around swings, slides, etc., marked off by hedge or low fence?

- Have you checked for incompatible elements such as parallel ladders and slides, or horizontal ladders and slides, placed too close together?

- Have you ensured no open platforms are placed next to swings?

- Have you placed equipment so that no slides descend in a direction where children are at play?

- Are slides positioned so that they are not facing south, making them too hot in summer for use by children in shorts?

A Final Word

- Have you set up a mechanism for periodic inspection of equipment and have you arranged for on-going maintenance and repair of grounds and equipment to ensure your children enjoy a clean, well-cared for play environment?

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